

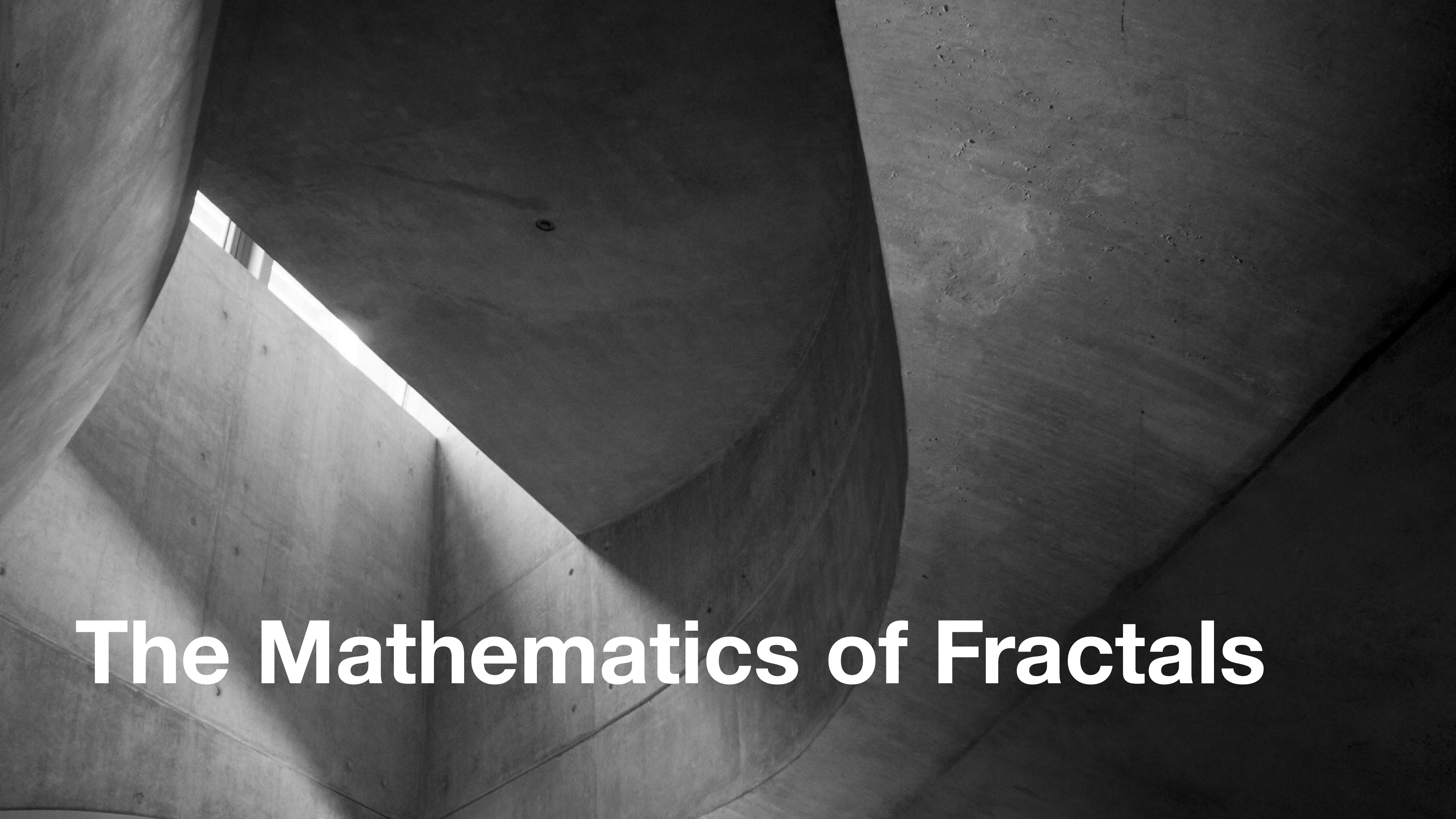
Fractals and Recursive Functions

Akaash Parthasarathy, Rohan Phadnis, Ansh Bhatti

The background features a dark blue gradient with subtle, flowing wavy patterns that create a sense of depth and movement.

“Roughness is a part of human life”

- Benoit Mandelbrot

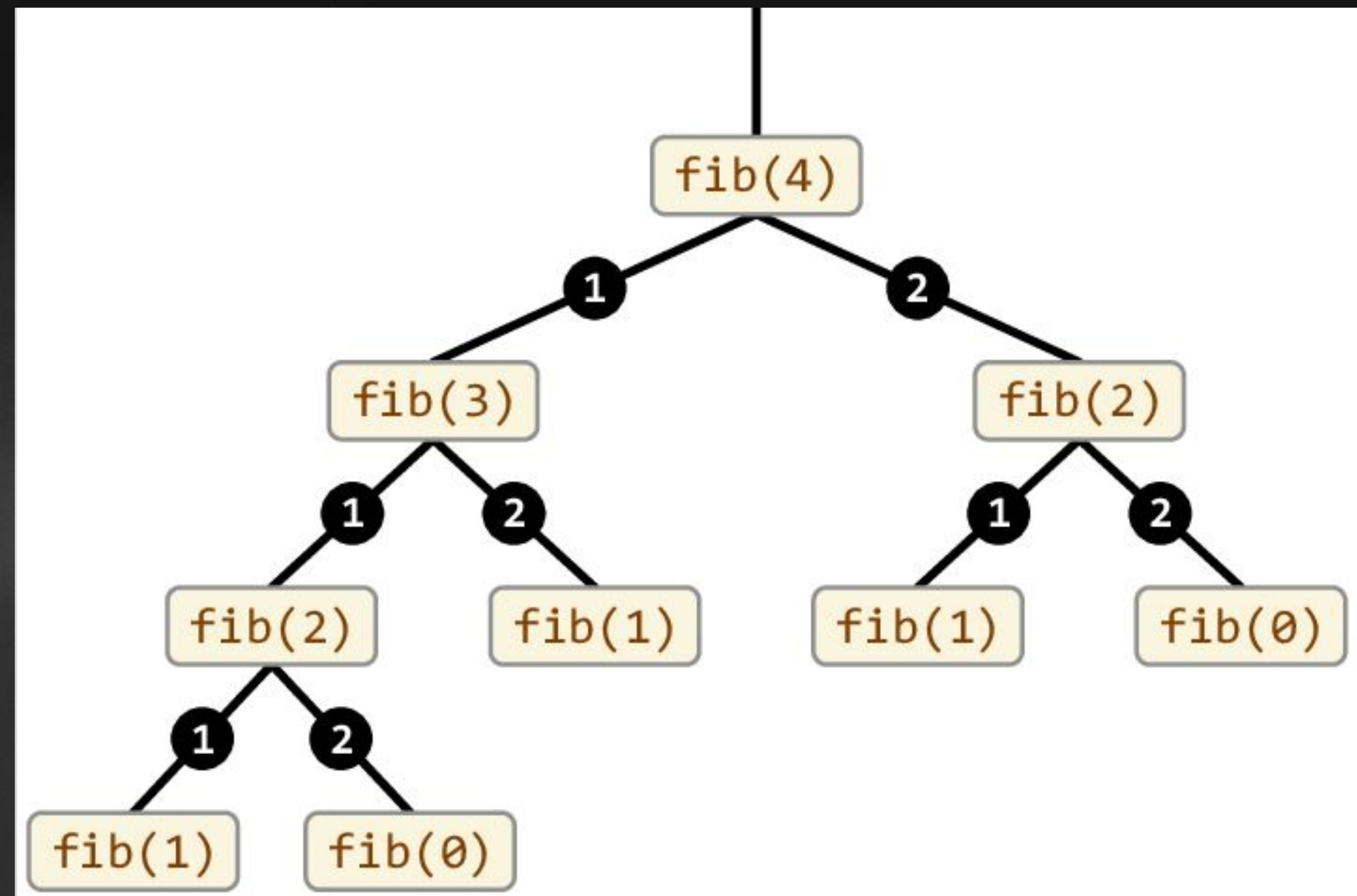


The Mathematics of Fractals

Recursion

A mathematical definition

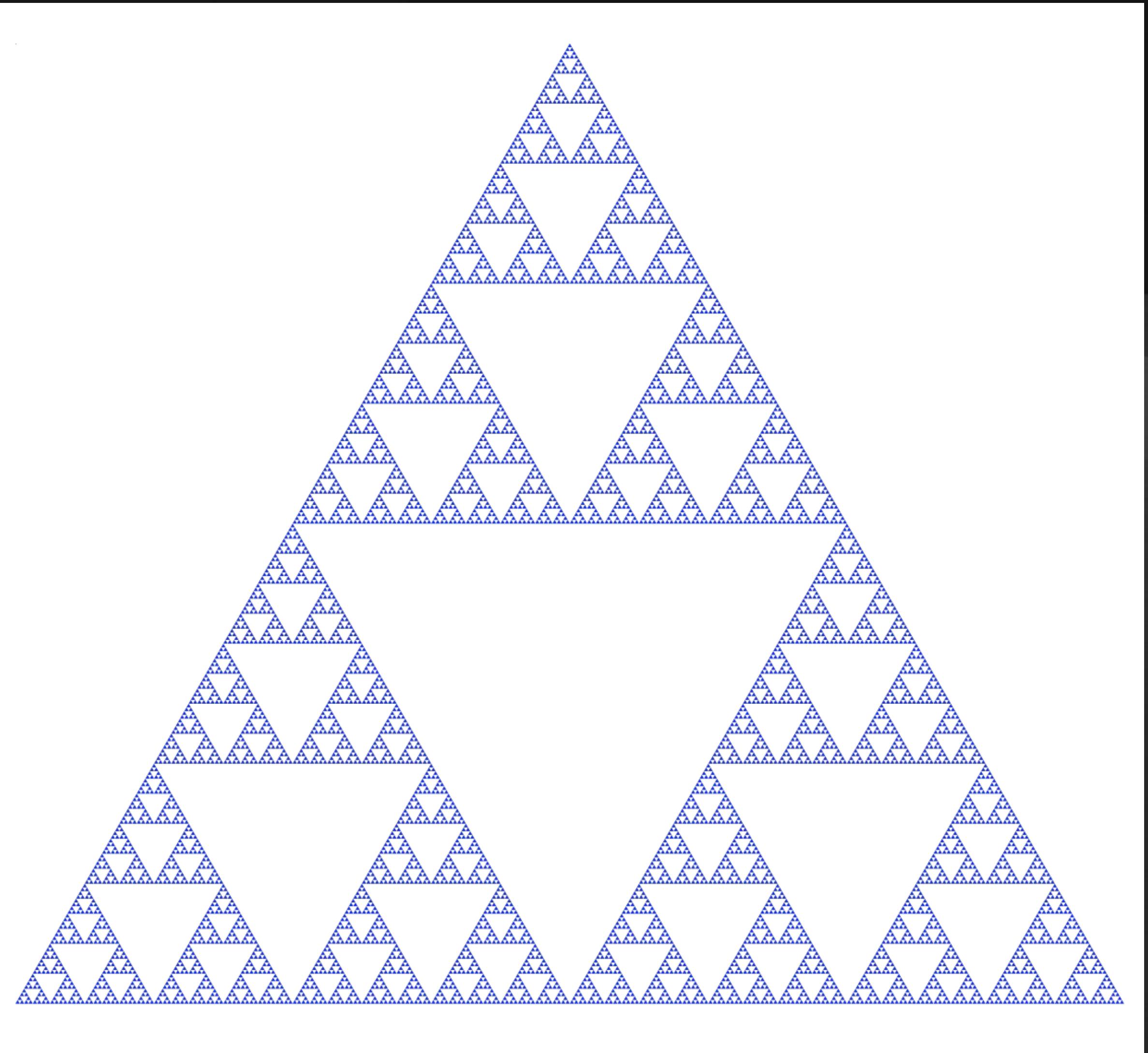
- Invokes itself to break problems into smaller, similar problems
- Finite Recursive Functions - base case
 - Factorial:
 - Fibonacci:
- Infinitely Recursive Functions - no base case; only theoretical



Fractals

A mathematical definition

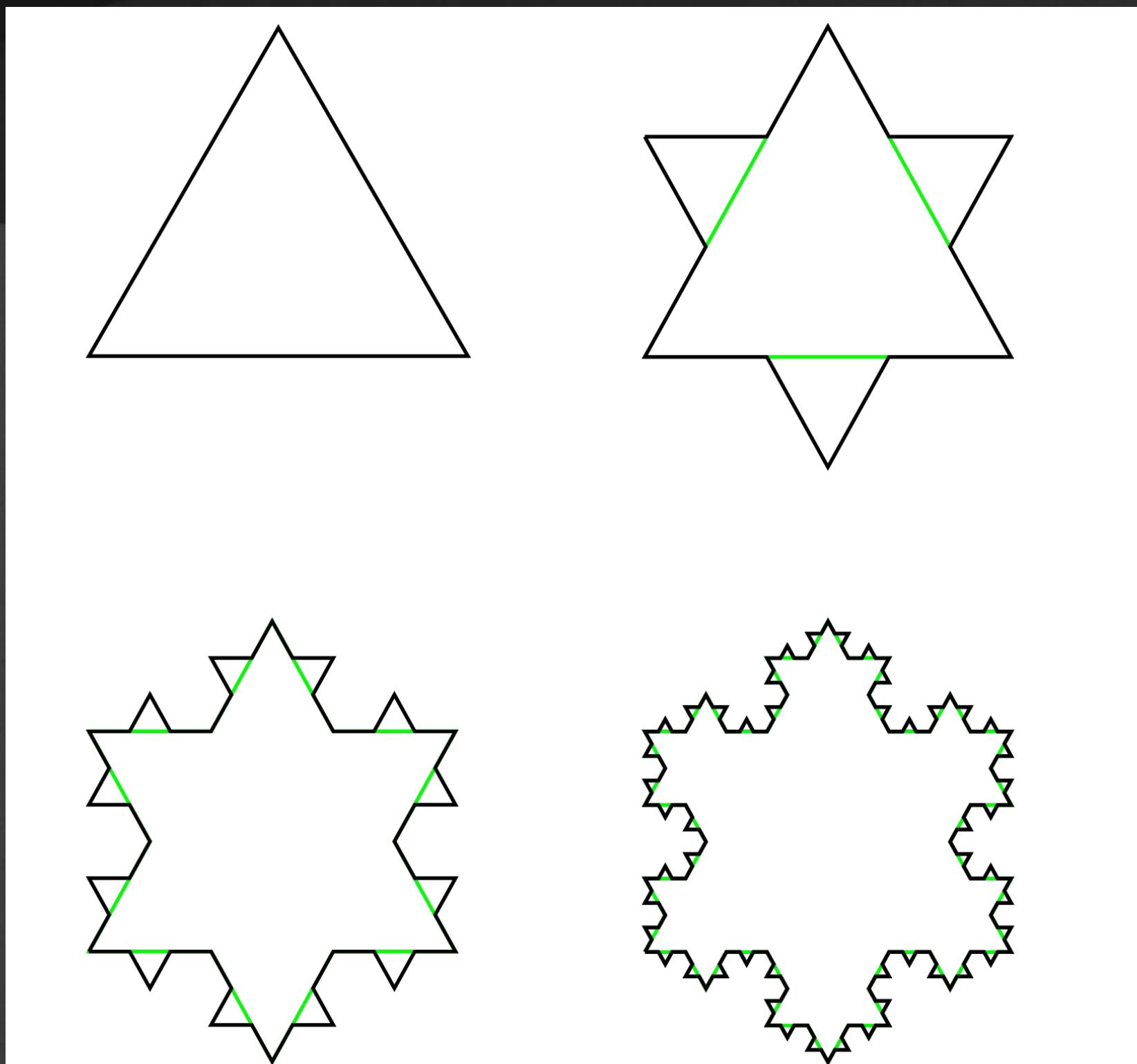
- Infinitely rough geometric shapes
- Self-similarity property
- Can be generated recursively



Koch Snowflake

A famous fractal

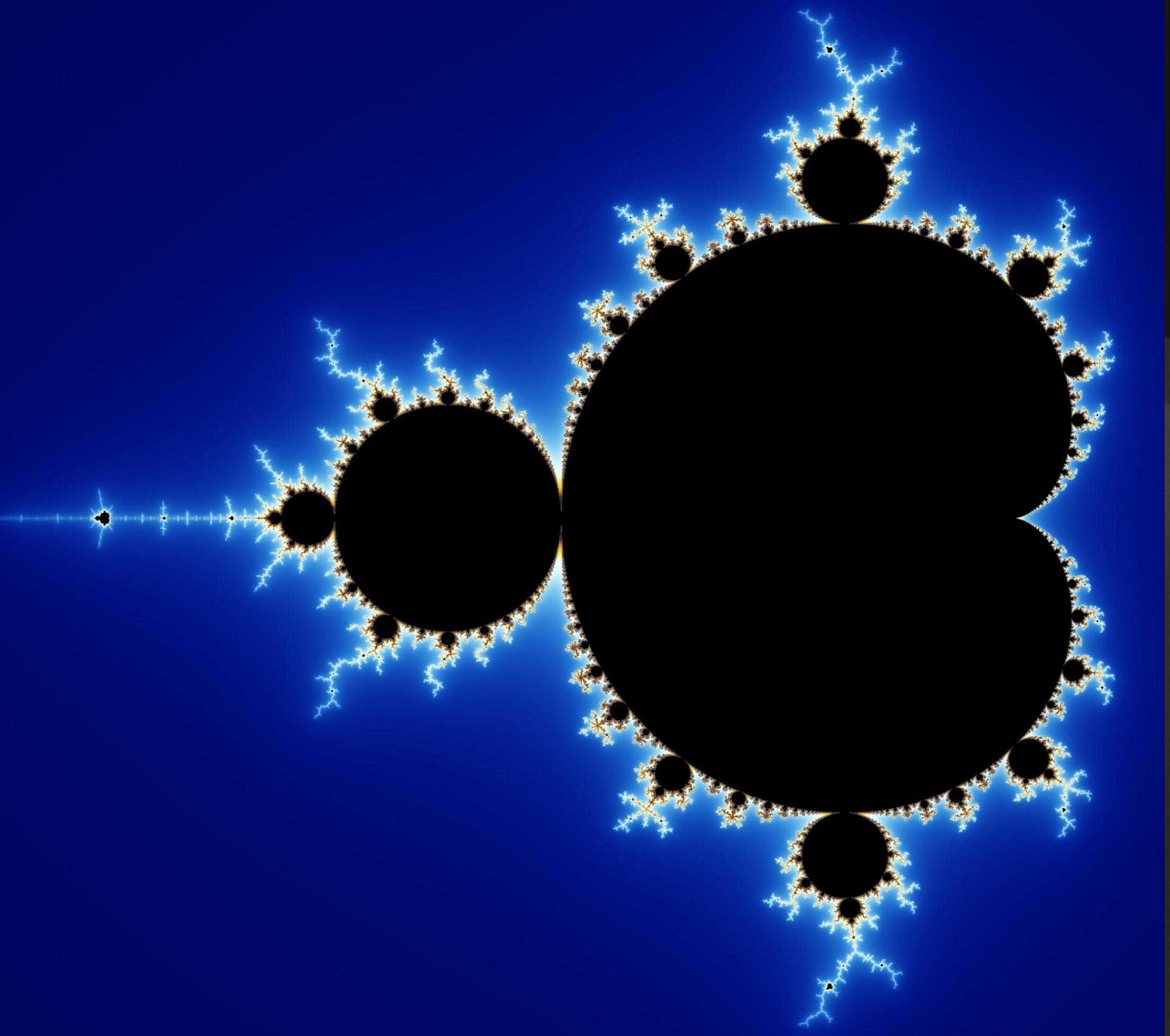
- Generated using equilateral triangles within equilateral triangles



Mandelbrot Set

Another famous fractal

- A self-repeating fractal generated using complex numbers
- Developed and theorized by Benoit Mandelbrot



Applications of Fractals

Fractal Image Compression

An application of self-similarity

- Images require lots of data
- Fractal compression by exploiting self-similarity in images
- Restoring original size
- Works best for patterns, natural landscape photos



Original



Zoomed-in



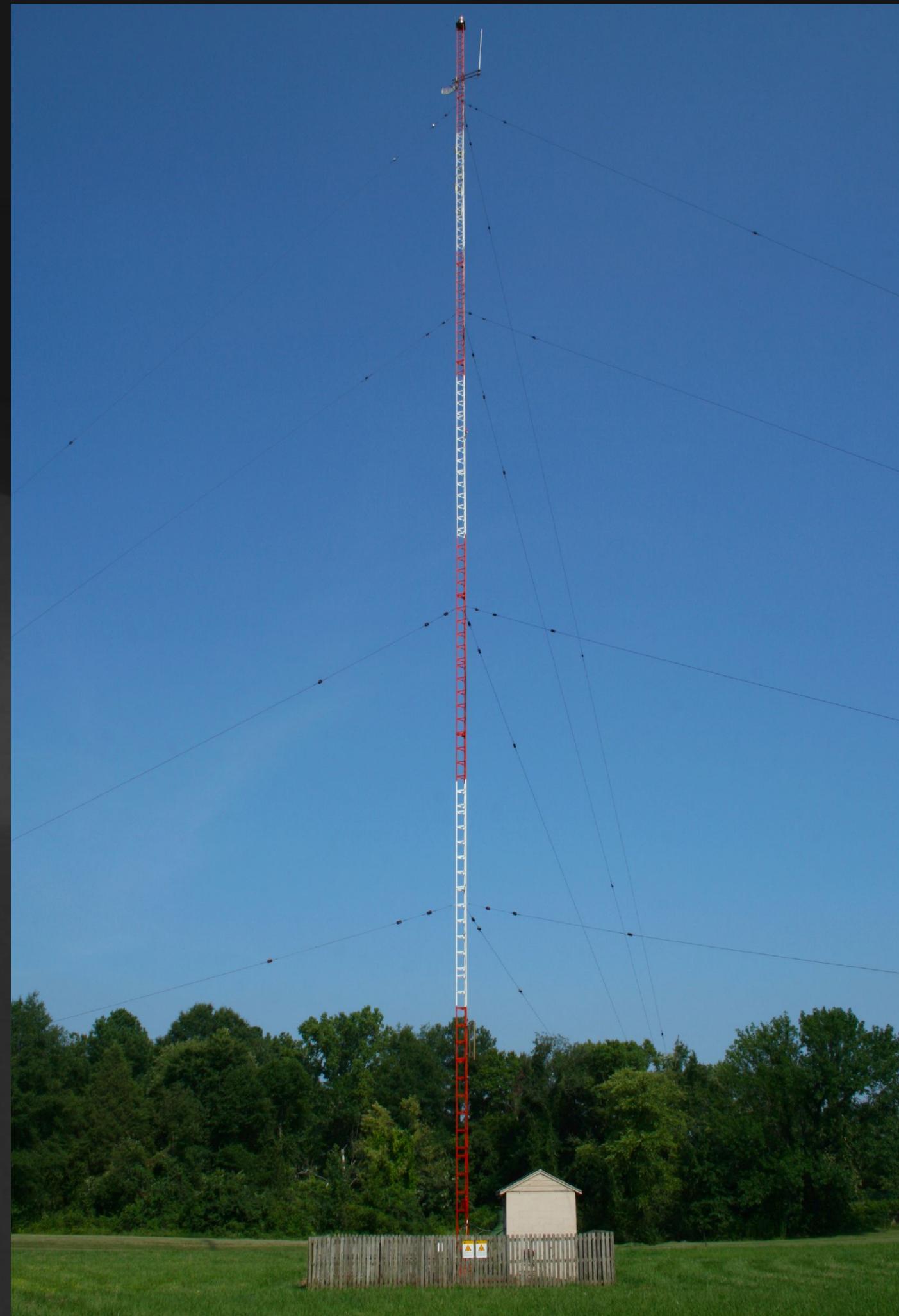
Resizing using Fractal Decompression

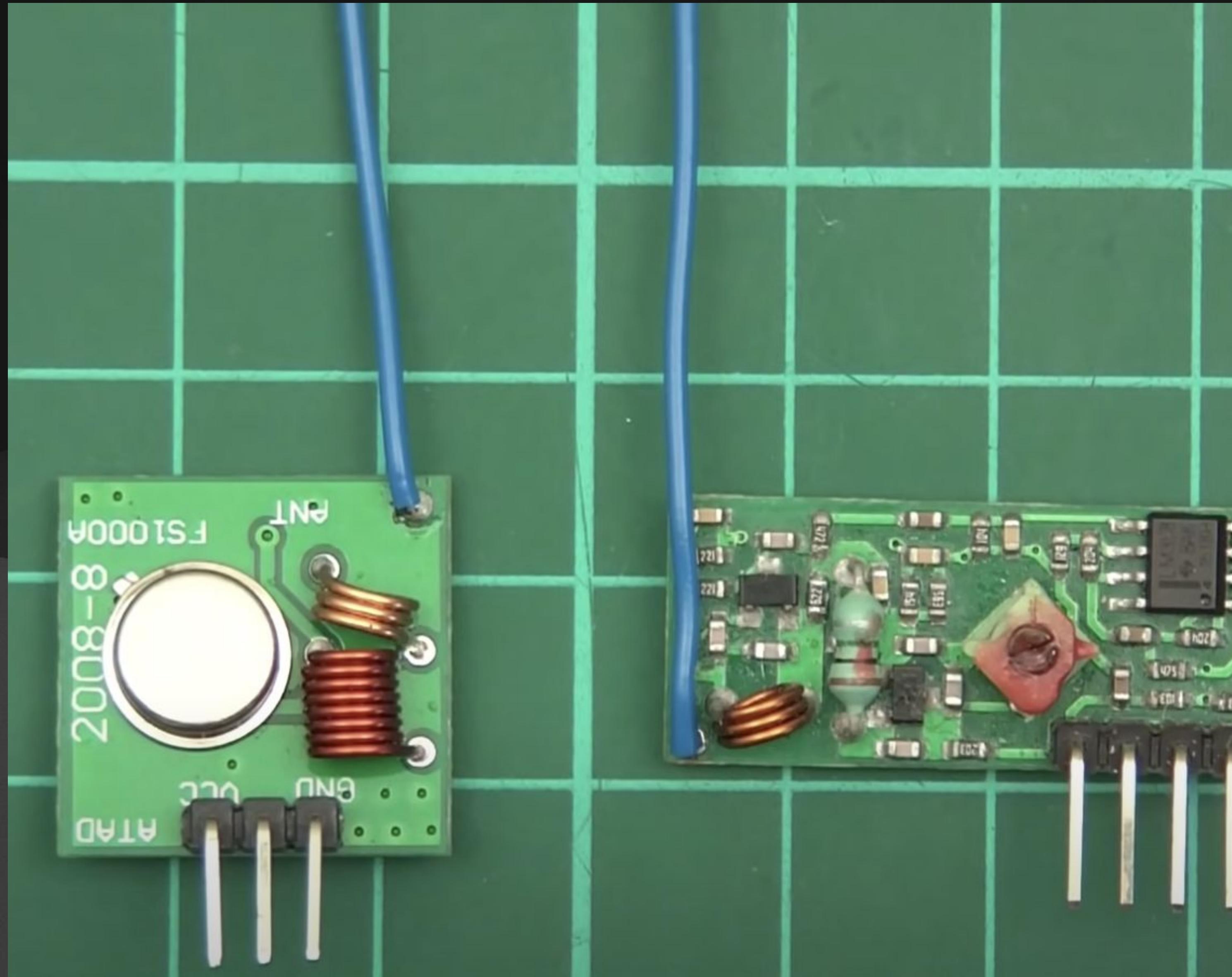
Fractal Antenna

Antenna

Science of antennae explained

- Piece of wire
- Current's magnitude and direction alternated
- Electromagnetic field generated
- Receiver antenna's current changes

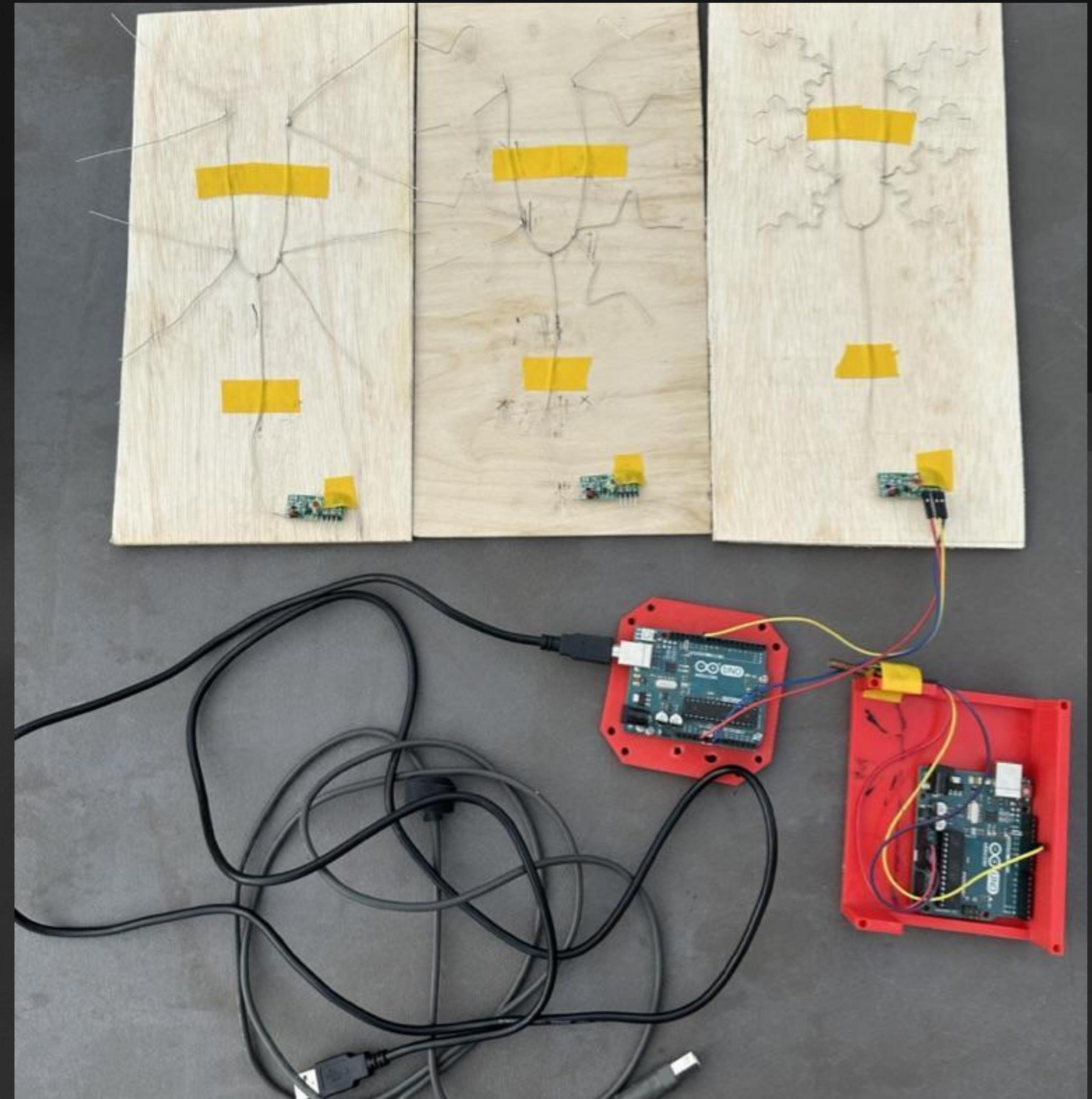


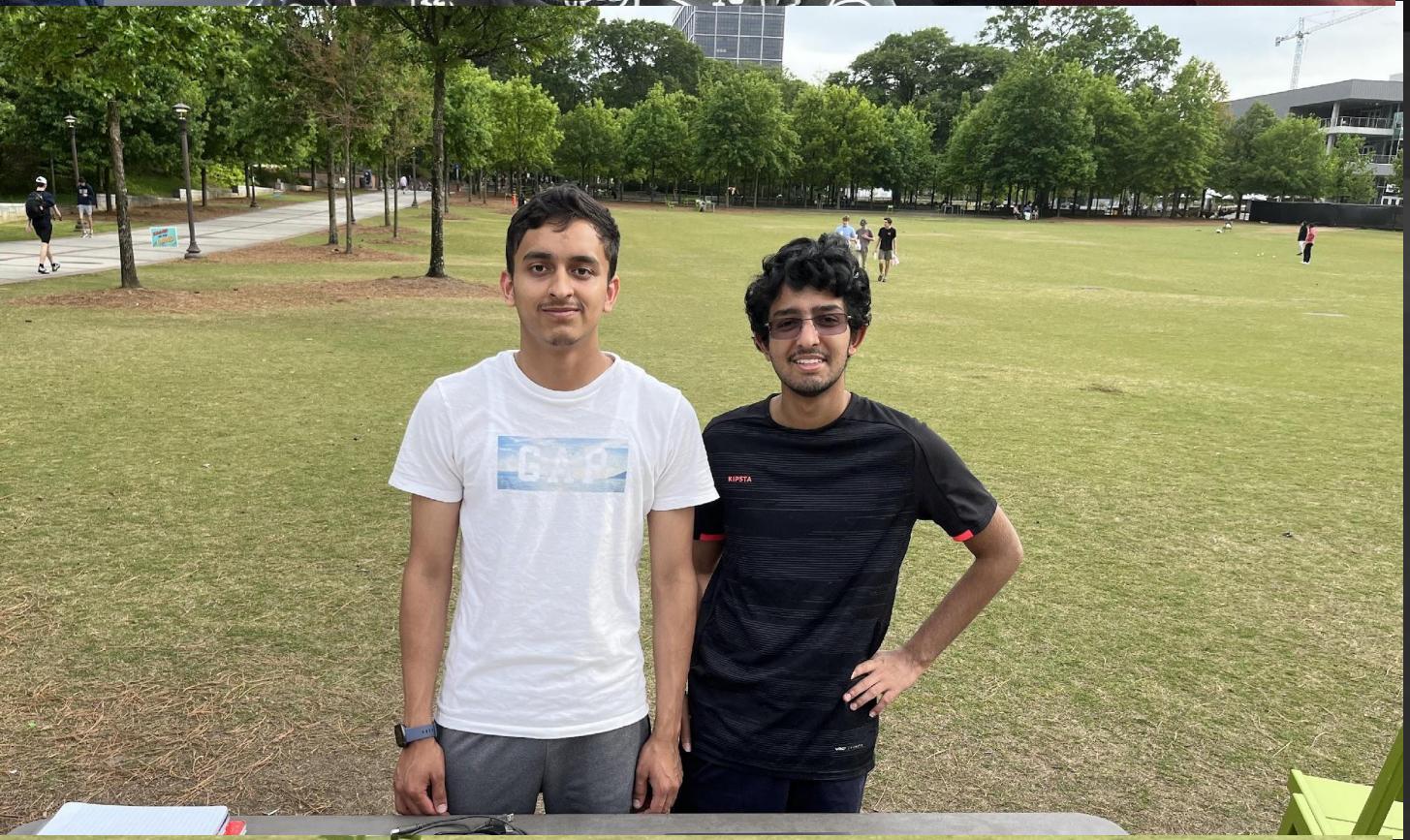
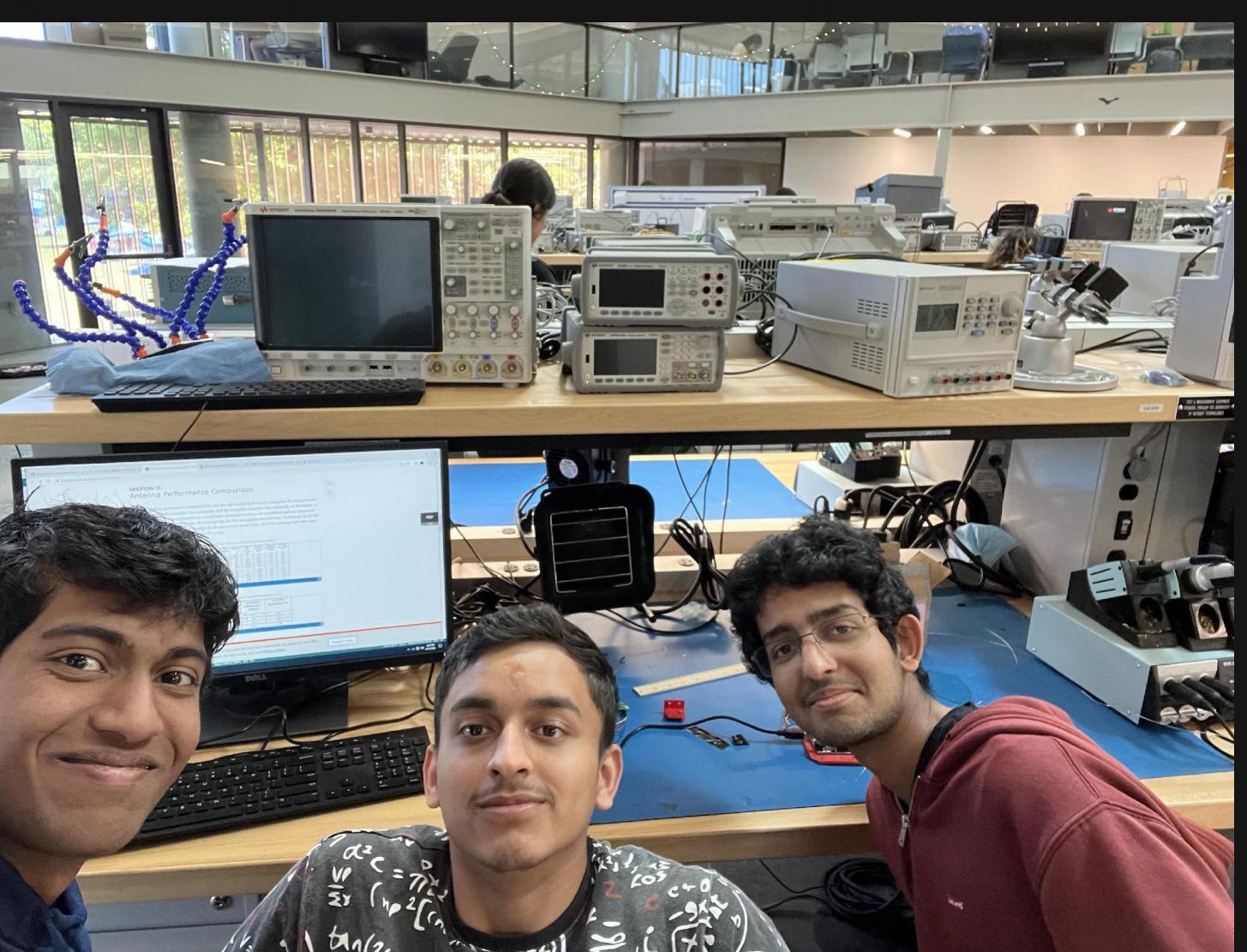


Experiment

Testing fractal antenna range

- Build 3 Antenna Setups of 0, 1, and 2 Koch Snowflake iterations
- Tested range of each setup





Data

Experimental Data and Key Insights

- Fractal Antennae's geometric shape
 - Allows more operational frequencies
 - Increases surface area of antenna
 - Range, reliability increases
- Bottleneck effect prevents widespread implementation

Iteration	Max Range
0	18.379m
1	25.512m
2	36.064m

Acknowledgements

Special Thanks To...

Thank You!